Chapter 2

Overview of Case Studies Used to Demonstrate Characteristics of Mistakes Made in Financial Analysis

Financial Theory, Financial Practice and the Global Financial Crisis

Much of this book explains somewhat technical approaches to mistakes in valuation through applying a combination of economic theory, mathematics and financial principles. While the understanding of any discipline requires knowledge of underlying technical and theoretical principles, when it comes to studying valuation, learning from past mistakes may be even more important. The idea behind presenting case histories of valuation mistakes before working through technical details of analytical models is both to introduce selected valuation topics is also to prompt thinking about the underlying valuation theory. The case histories included in the chapters contain analysis that generally resulted in bad investment decisions that caused equity and/or debt investors to lose a lot of money although in some cases it was consumers who were the losers.

The chaotic period in the financial markets that began in the summer of 2008 referred to as the global financial crisis is used to introduce case studies and a number of common valuation mistakes. The financial crisis experience could have been used by academics and practitioners as an indication that they need to go back to harbor and take a hard look at everything from efficient market theories to models such as the CAPM to the basic question of what constitutes risk to how financial models are constructed. It was not. A number of theories, models, and financial strategies routinely used in valuation have proven to be erroneous or, more often and more important, simply irrelevant in explaining dramatic volatility of asset values. Just about all of the valuation errors that will be discussed in other case studies were also part of the lead-up to the financial crisis.

Many books, films, articles and YouTube videos have attempted to explain what happened in the financial crisis and the discussion below is in no way intended to be some sort of definitive treatment. The idea here is not to delve into details of valuing structured investments, discuss systematic risk or comment on credit default swaps that were famous in the crisis. Instead, the review takes a step back and points out analogies of valuation errors that were made in the housing crisis to flaws that seem to recur in valuing other project finance and corporate investments. Other case studies discussed in subsequent chapters are mentions in the description of the valuation errors. Some of the analysis mistakes made in the financial crisis that are also present in many of the other valuation failures described in subsequent chapters include:

- Using comparative benchmarks from relative valuation to justify the valuation that does not make sense.
- Not accounting for potential surplus capacity when making cash flow forecasts in capital intensive industries that can lead to surplus capacity and price volatility.
- Assuming value can be created from continually earning high returns in cases were monopoly power does not exist.
- Credit analysis that extrapolates from the wrong historic data in evaluating repayment probability
- Failure of fully thought-out downside scenario analysis in evaluating risks associated with contracts
- Not using simple analytical checks to avoid financial jargon when evaluating investments
- Believing that new-fangled financial products can change the fundamental relationship between risk and return
- Applying mathematical analysis to simulate risk when variables do not follow conventional statistical patterns
- Over-reliance on the opinions of experts who have no vested interest in the investment.

Using Relative Valuation to Justify High Valuations that are Not Rational

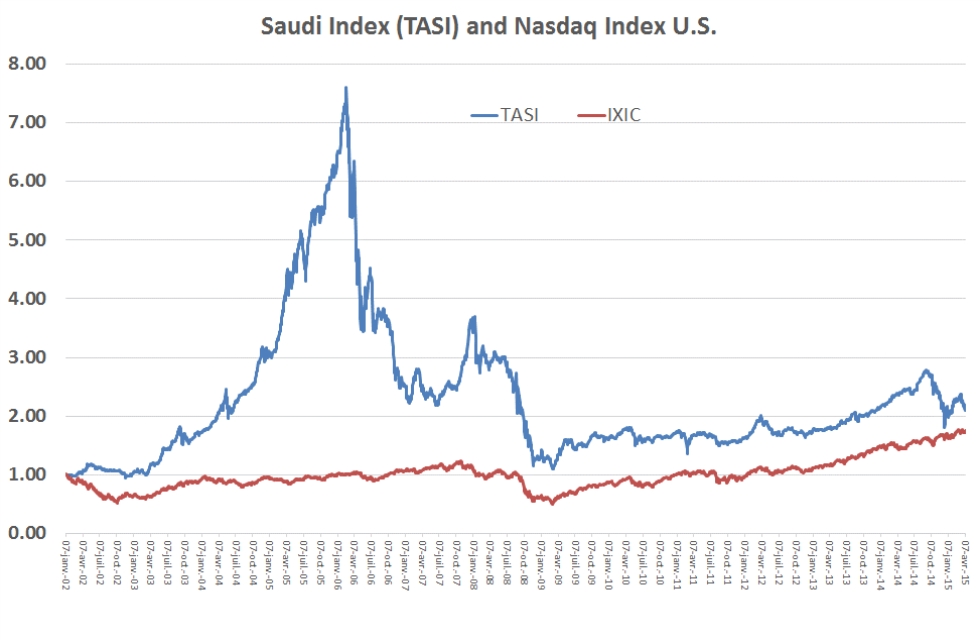
The fundamental problem underneath the housing crisis that subsequently was the major cause of the global financial crisis was valuation of real estate and

more specifically the bursting of a bubble in housing values in the U.S. The first and perhaps the most surprising error made by so many analysts, investors and bankers in the mortgage crisis was the implicit or explicit assumption that values of homes and other real estate would continue to increase at the same time supply was increasing quickly relative to demand. With the benefit of hindsight, this was not rational from a very basic economic perspective. Valuations that result in price bubbles and do not make sense (again, with hindsight) are often the result of making some kind of benchmark comparison rather than performing independent analysis of the economics of the investment. Many valuation problems discussed in later chapters (Petrozuata, Kitty Hawk, and Constellation Energy) arise in part from using inappropriate benchmark comparisons of financial ratios, whether the ratios being compared are P/E ratios, DSCR indicators, political risk premia, or the price of similar houses. The danger arises when the underlying economic implications of these financial indicators is not recognized and where one transaction is gauged relative to another one using a financial ratio benchmark without considering underlying economic fundamentals.

After the dot com collapse and the global financial crisis it has become fashionable to discuss price bubbles and prognosticate about the next bubble that may burst. As with many topics that are discussed in the financial press, the actual definition of a bubble doesn't seem to matter much to experts on the television whose main objective is to sound smart, speak fast and invent new terms. For purposes of the discussion here, a price bubble is defined to occur when the price of something clearly exceeds its inherent value. In the case of a stock, the inherent value is the discounted future value of dividends and earnings. For a house, the inherent value can be defined by the cost of land, material and labor for building a new house. True believers in efficient markets (who have often spent time at the University of Chicago) maintain that there is no such thing as a price bubble or irrational prices and that price increases or declines that some may label as a bubble are the result of some kind of changed expectations. The valuation lesson from the financial crisis and in many of the other cases is that some kind of independent analysis using economic fundamentals is important and the values are not always rational.

One way price bubbles can be sustained is when valuations are explained by comparison with other assets that also have inflated values. Bubbles can occur when people see prices increasing and they do not want the empty feeling of missing out on making money. In using relative valuation and comparable benchmarks to justify prices, new metrics are often invented that cannot be verified from analysis of historic data. A bubble occurred in for Saudi Arabian stocks before it crashed in 2006 that made the dot com bubble in the U.S. seem mild. This bubble in Saudi stock prices is illustrated by comparing the index of

Saudi stocks to the NASDAQ index in Figure 2.1.[1] When prices were on their upward trajectory in Saudi Arabia, valuation benchmarks measured by P/E and EV/EBITDA ratios reached extremely high levels that could not possibly be explained by cash flow and earnings fundamentals. People just kept buying stocks because they believed in things like momentum and in stories told to them that the Saudi market was different from other markets because of things like limitations on foreign investment. There were many sad histories of school teachers, doctors and others selling their houses in order to buy stocks when they were on the way up, only to lose everything in a few months.

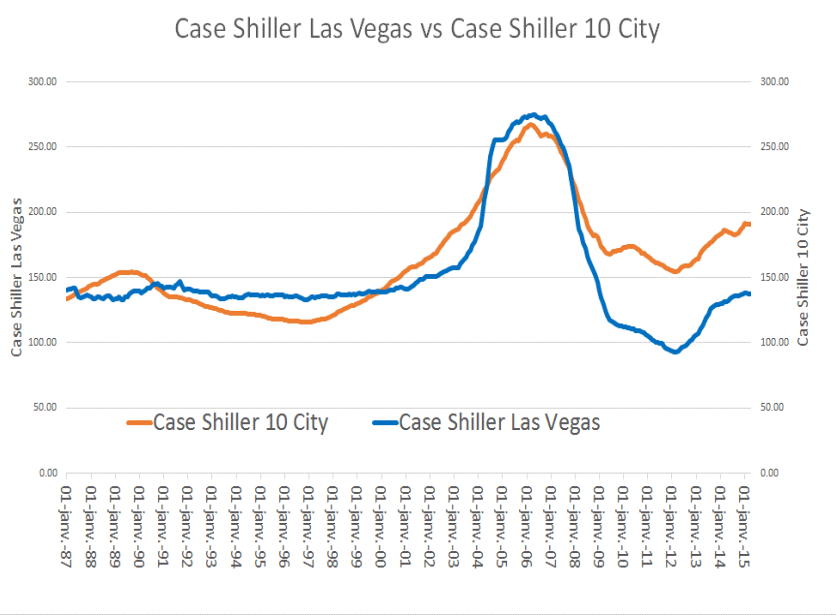


In the context of housing prices and the global financial crisis, investors and lenders did not look at the economic fundamentals driven by what it really cost to build a new home. Instead, they came up with esoteric theories associated with the demand for housing and concocted similar explanations as with the Saudi market of why things are really different this time. Worse, the housing price inflation was somehow attributed to financing and the high demand for mortgages arising from collateralized mortgage obligations. Ideas that housing price increases and potential bursting of the bubble would be isolated to one regional area and risks of housing price reductions could somehow be diversified were just as silly. Nobel Prize laureate Robert Schiller explains valuations during bubbles by beliefs of investors that some kind of undefined smart minds must know what is really happening: People give "increasing credibility to stories … that appear to justify

[1] The source of this data is an analysis of Googlefinance. Methods of downloading the data and creating the graph can be found at www.edbodmer.com/

the belief that the boom will continue. People think the world [that results in price movements] is led by independent minds who invariability act with great intelligence."[2] Similar phenomena of valuations that did correspond to underlying valuations occurred in the Iridium telecom case and the peaking plant valuation case discussed in Chapters __ and ___.

Price bubbles in Las Vegas and U.S. real estate markets before and after 2008 are shown in Figure 2.2[3]. The prices displayed in Figure 2.2 are adjusted for inflation. A fundamental notion of just about any market without monopoly power, is prices have some relation with the cost marginal cost of production, or in the case of residential real-estate, the cost of building a new home. The idea that prices in 2004-2007 had anything to do with the cost of building new houses or other economic principals associated with production cost seemed not to matter anymore.



Trends in prices shown in the Figure 2.2 demonstrate that real prices of homes did not keep increasing or remain at the high levels experienced before 2006. With hindsight, price declines that began in 2007 should have been expected as they have simply reverted back to long-run equilibrium levels which have been quite flat in inflation adjusted terms. Both surplus capacity in the

[2] Shiller
[3] This and other economic time series are downloaded from the St. Louis Federal Reserve Bank website. Descriptions of how to make flexible graphs and download automatically are available on the website www.edbodmer.com

market and diminishing demand for new homes after the market was saturated meant that declining house prices should have at minimum been considered a reasonable possibility in any valuation analysis. The decline in house prices after 2007 meant that that they were simply following a cyclical pattern and reverting to their long-run marginal cost. This lesson certainly does not only apply to real estate and was present in the AES Drax case discussed in Chapter ___ as well as the Eurotunnel case discussed in Chapter ___.

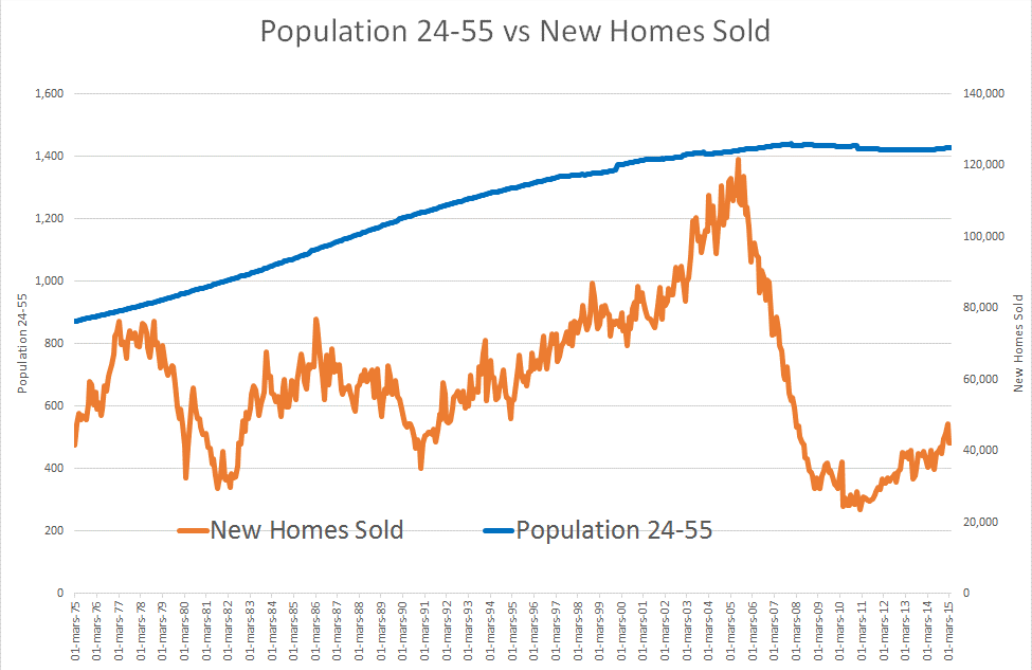
A potential reason that prices kept on increasing is the way appraisers would value individual homes. Valuation of a particular home would be derived from a sample of similar transactions in a region in an analogous manner to the way stocks are often valued by using a sample of P/E ratios. But in creating a comparable analysis of similar transactions, homes that had a relatively low value would often be left out of the comparative sample because of some supposedly non-comparable criteria (if the appraiser did not make this kind of adjustment, other appraisers would be hired). The valuation of a particular home would then be pushed up, meaning larger loans could be obtained and overall prices would rise. This is like selectively limiting samples when making comparisons of the P/E ratio or the EV/EBITDA ratio. Over the tenure of the increase in house prices shown in Figure 2.2, the cost inputs to housing -- building materials such as lumber and cement; the cost of labor; the cost of capital and even the cost of land that drive the change in the marginal cost of housing -- were relatively stable meaning that the valuations could not be explained by the most basic of economic principles. The implication is that when any kind of valuation benchmark is used, the underlying economic drivers of that benchmark must be understood.

Not Accounting for Cash Flow Volatility from Potential Surplus Capacity and Industry Demand

Valuation involves implicitly or explicitly forecasting future cash flows and attributing risk to those cash flows. Making projections of future prices and understanding the potential volatility in prices is more often than not central to the valuation process. When looking forward, the potential for large swings in price occurs when industry capacity increases faster than demand. The possibility of large price swings is more pronounced when investments in the industry are capital intensive. In economic parlance, prices can very suddenly fall from levels that are above long-run marginal cost all the way down to short-run marginal cost. For capital intensive industries like shipping, real estate, oil production, airlines,

telecommunication and electricity, this matters a lot because the difference between long-run marginal cost and short-term marginal cost is large.

At the height of the housing boom, new homes were being constructed at a record pace and the surplus capacity of residential homes should have been clear to anybody who simply drove around sprawling suburban areas of American cities. Just by looking at all of the new homes and wondering who was moving there, questions should have been raised about a potential crash in home values as a result of the surplus capacity. The increase in supply of homes relative to the demand for homes (expressed in terms of population) is demonstrated on Figure 2.3. The graph shows that new homes were being built at a record pace for a long time period. Relative to stable population of home buying age, the graph demonstrates that surplus capacity was increasing[4].

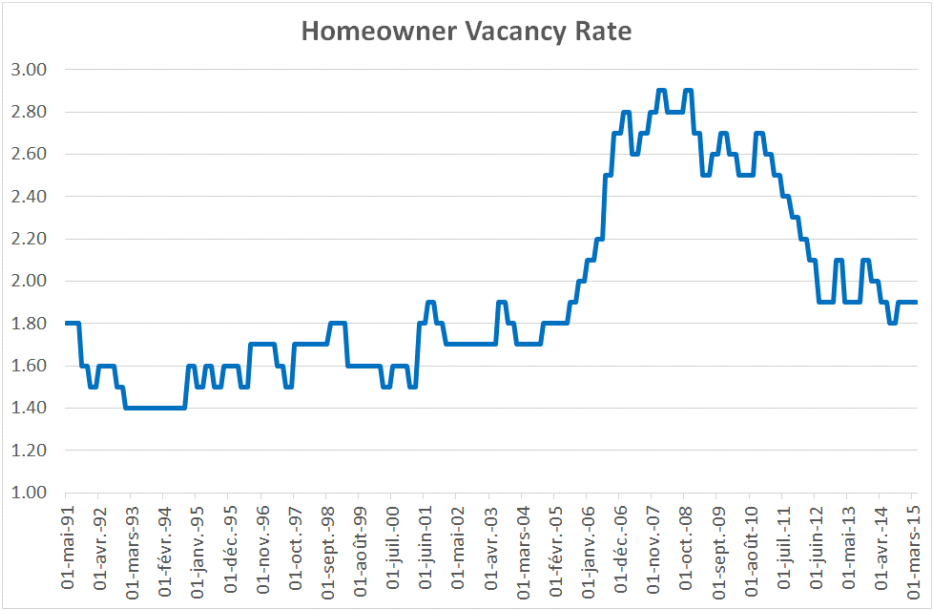


Despite the surplus capacity illustrated in Figure 2.3, risks of downward volatility in prices were not considered even by large sophisticated institutions. The way in which fundamental economics of surplus capacity was ignored is documented by Michael Lewis: "Loans were granted on the presumption that housing prices would follow trends experienced since 2000, and continue to increase. After all, nominal housing prices had not fallen on an annual basis since

[4] The data is from the St. Louis Federal Reserve Bank. Instructions on how to automatically download data and summarize the data can be found on the website www.edbodmer.com.

World War II. According to one story, an investor called the rating agency Standard & Poor's and asked what would happen to default rates if real estate prices fell. The man at S&P couldn't say; its model for home prices had no ability to accept a negative number. 'They were just assuming home prices would keep going up…'"[5]

Figure 2.4 displays surplus capacity in housing industry with a graph of the inventory of vacant homes for sale. Vacant homes reached their peak shortly after prices were spiking in 2006. This is the inverse of what normally occurs from the standpoint of basic supply and demand analysis where an excess of inventory would normally imply low prices. As with the demand and supply in Figure 2.3, this public data indicated that there was surplus capacity in the market and a danger of prices crashing should not have been surprising. At the time, supply and demand data was apparently ignored.



The AES Drax case discussed in Chapter ___ , the peaker plant case discussed in Chapter ___ and the Quezon case in Chapter ___ involve declines in prices that occur after periods of surplus capacity for capital intensive industries and the effects on equity and debt valuation. Once historic industry data is acquired for corporate finance analysis or benchmark information is developed for evaluation of project finance, the question of whether this information can be used in future projections depends on some kind of industry analysis and cannot be evaluated just by looking at recent price trends. If the investment is made in capital intensive industries, the potential for surplus capacity is a key question of

[5] Lewis, ibid.

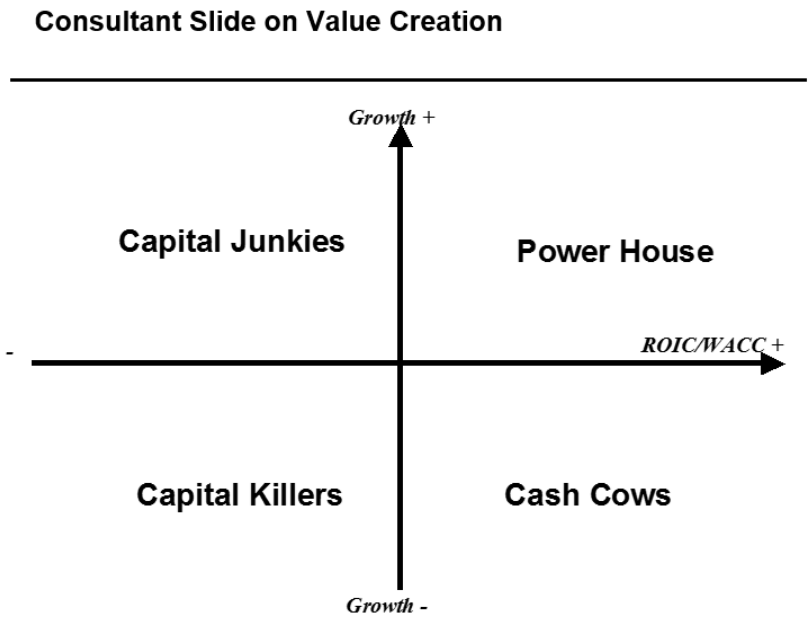
whether the historic or benchmark information can be assumed to continue. In contrast, problems of price volatility driven by surplus capacity is less pronounced for non-capital intensive sectors. When there are too many street vendors in Prague selling sausages, the vendors can close down and perhaps move somewhere else or even change professions. The surplus capacity then goes away quickly. For real estate, telecommunication, oil production, electricity generation and many other capital intensive industries, when surplus capacity arises it does not go away for a long time and the excess can cause prices to suddenly move from above long-run marginal cost to short-run marginal cost.

Believing that High Returns can continually be earned in Non-Monopoly Industries

Perhaps the most basic notion about valuation is the idea that value comes from earning returns above the cost of capital. This fundamental concept will be used in later chapters when developing financial models of valuation and the idea will be discussed in other case studies. Companies that have generated enormous value such as Google, Microsoft, McDonalds and Apple have earned returns above their cost of capital and also at the same time been able to grow their business. These companies would be put into the power house square of the matrix shown on Figure 2.5. Power house companies that are able to sustain a return on investment – ROIC or project IRR – above their risk adjusted cost of capital – WACC – and also grow at the same time will have increases in stock price, high P/E ratios, price to book ratios far above 1.0 and generally revered in by financial analysts. These companies have been able to gain some kind of monopoly power by virtue of their size, their marketing or perception that their products cannot be copied. This can come from making people addicted to your coffee or soft drink (Starbucks and Coke); developing a media empire that makes people believe they can only be happy if they spend time waiting lines for special rides on machines that last a couple of minutes and have their pictures taken next to a cartoon character (Disney); getting people used to using your software and becoming large enough to buy companies like YouTube (Google); or making teenagers addicted to computer games (Microsoft and Xbox).

The valuation problem with the matrix shown on Figure 2.5 is that other individuals and companies want to believe they are also in the powerhouse square, but their situation is temporary. When competitors can move into an industry after seeing high returns, surplus capacity can suddenly arise and price declines dramatically reduce rates of return. Suddenly, the companies are no longer in the power house square but rather in the worst square of all, the capital junkie square. Their value plummets, the P/E ratio crashes and the price to book ratio falls to

below 1.0. This issue is central to the First Solar case study in Chapter ___ and the Kitty Hawk case study in Chapter ___.



In the run-up to the housing crisis and the fall in real estate values, individuals and corporations implicitly believed they were in the power house square, but they were not doing anything very special at all. Before the housing crisis, many people believed they had some kind of special skill in buying houses, borrowing money and then re-selling the house. Similarly, large investment firms believed they were doing something unique by putting together loans in a package and re-selling the loans. People who bought and re-sold houses when the prices were increasing were could make high returns when the increase in housing prices was more than the interest rate. The ROIC in Figure 2.5 could be thought of as the increase in housing price and the WACC would be the cost of borrowing. Naturally, and more people wanted in on the action. Large financial corporations like Lehman Brothers were making a lot of money through buying mortgages and then re-selling the mortgages enabling them to earn large fees without making a direct investment. Evidence of the high returns made by these kind of financial corporations were the large bonuses paid to just about all of their employees. The idea of making a profit through borrowing money to buy and re-sell houses is explained as follows: "a surprising number of sub-primes went to affluent people stretching for second homes."[6] "[L]enders welcomed "flippers" – people buying houses solely for the purpose of reselling in a year or so. By 2005, 40% of all

[6] Richard Bittner

home purchases were either for investment or for second homes….a large share of the 'second homes' actually were speculations for resale."[7]

As in so many other cases such as the Dahbol case from Chapter ___ and the Petrozuata case from Chapter 3, the valuation lesson is that when making an easy return seems too good to be true it probably is. The returns being earned were only possible by taking a big risk that the price of houses would not fall. As more and more people went into the market and pushed up the price of homes, the probability of home values falling increased. When this happened, people who were flipping homes were left with loans that did not come close to covering the value of the house were left "underwater." Financial institutions that paid large bonuses were left with mortgages that had a far lower value. With hindsight, believing that you are in the powerhouse square when you were doing nothing special was a very dangerous strategy as is paying a high P/E ratio for a company that is in a competitive business. People and financial institutions that had been so anxious to grow their business suddenly found themselves in the capital junkie square of Figure 2.3 where a lot of money is thrown away on investments that do not cover the opportunity cost of capital.

The implication of this return on investment lesson from the financial crisis to corporate and project finance analysis is to carefully analyze projected returns on capital as the starting point of an investment analysis. In project finance, if an investment is projected to earn a high return and others can make similar investments, the first question that must be asked is how this situation can be possible (as was the case for merchant electricity plants discussed in Chapter __). For corporate analysis, when a financial model forecasts that the return on investment will increase or even when the return will remain high, you should stop and ask what is so special about the company (as for the solar industry before 2012 discussed in Chapter ___).

Credit Analysis that Extrapolates from the Wrong Data in Evaluating Repayment Probability

Valuation analysis in this book addresses the manner in which debt is evaluated as well as how to analyze equity investments. Many of the case studies in subsequent chapters involve losses on debt as well as declines in the value of equity. Flaws with the credit analysis and valuation of debt securities were without much doubt the analytical factor in bringing down financial markets during the

[7] Charles Morristo

financial crisis. Mistakes in debt valuation and credit analysis that lead up to the financial crisis involved problems both in terms of individual loans such as the sub-prime mortgages that were offered and difficulties with credit analysis of loan packages called collateralized debt obligations (CDO's) or collateralized mortgage obligations (CMO's). The credit analysis of the individual sup-prime loans are closely related to packaged loans because the loan packages consisted of various aggregations of the individual debts. One of the principal drivers of the financial crisis was the inappropriate way the potential defaults on the individual loans were evaluated.

From the perspective of financial theory, there are many analogies between debt and equity. Both debt and equity involve understanding appropriate benchmarks. For equity, the benchmark may be the P/E ratio, the EV/EBITDA ratio or the P/E ratio. For debt the benchmark could be debt to equity, DSCR or the debt to EBITDA ratio. Both debt and equity analysis involve cost of capital analysis. For equity, cost of capital can be estimated by the CAPM or another technique such as a regression analysis of the price to book ratio discussed in Part 2. For debt, cost of capital involves measuring credit spreads and the probability of default. Finally, both debt and equity require some kind of explicit or implicit forecast that should reflect economic theory and may include stochastic mathematical analysis. These subjects are addressed later on in the text.

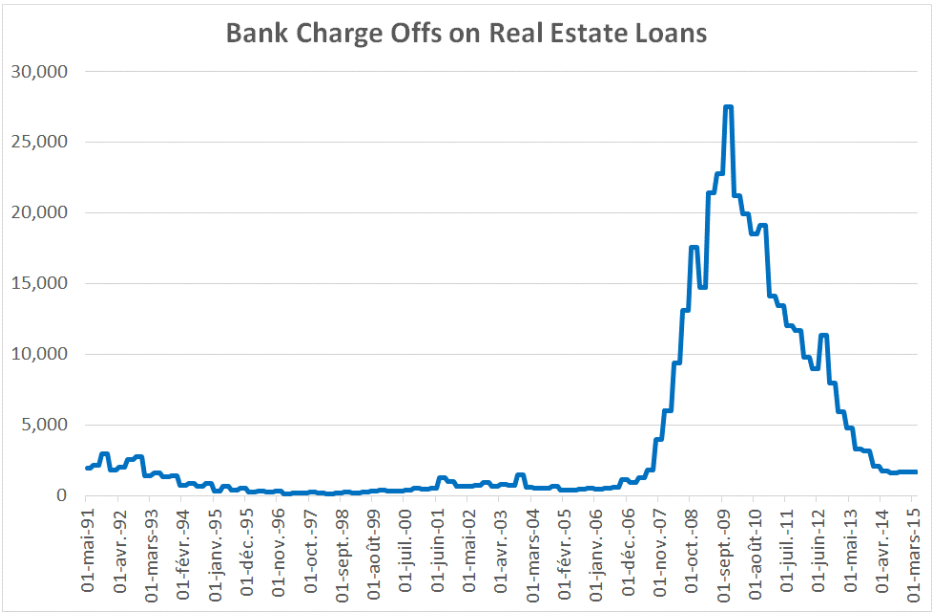
In considering problems associated with lending practices, subprime loans can be used to illustrate the valuation flaws. According to one source, sub-prime lending jumped from an annual volume of $145 million in 2001 to $625 million in 2005 and represented more than 20% of total new debt issuances.[8] To demonstrate flaws in valuation that were part of the financial crisis, consider a product called a NINJA loan. The letters of this financial product meant No Income, No Job, and no Assets. While the loan terms in the NINJA documents were extreme and applied at the peak of aggressive lending before the financial crisis, the thinking that went into this type of loan demonstrated flaws in credit analysis that started with the general idea that loans could be made solely on the basis of the value of the home that was purchased. Examples other than NINJA loans were stated income loans where income was not documented and loans where "brokers would grossly exaggerated income and arrange two mortgages... one a loan for her down payment, the other an adjustable rate mortgage on the home." Presumably the notion was that as long as the value of the home increased, even if a borrower had no income, no job and no other assets, as long as the home could be sold at a value more than the amount of the loan, the debt could still be repaid. Further, people who borrowed money on this basis did not have much if any money to make a down payment on a house, and therefore amount of the loan relative to the value of the house was high. Understanding the basis upon which individual loans were made to people buying houses was probably more important than worrying how

[8] Source:

loans were put together in complex packages, as the value of the loan packages at the end of the day were made up of individual loans.

When performing credit analysis that is the basis for valuing loans, bankers and other lenders should begin with the fundamental question of how loans will be repaid. Three general methods of repayment include: (1) payment of debt service (interest plus principal payments) from cash flow (salaries for an individual, EBITDA for a corporation); (2) payment of loans by making new loans, meaning that the loans will be re-financed because of confidence in the strength of the company or individual and the potential for future cash flow generation; or (3) payment of loans by selling the assets that are the collateral for making the loans. Responsible lending generally means that at least two of the repayment sources are evaluated and asset sales are generally termed the second way out. In determining the probability that loans will be repaid, each of these sources of repayment can be calibrated to financial ratio benchmarks. Repayment from cash flow can be measured through a debt service coverage ratio (DSCR) that gauges the percentage reduction in cash flow that can be withstood before a loan defaults. Relationships between the DSCR and the probability of default are a function of the volatility of cash flow. With more cash flow volatility, higher debt service cushions are required. Re-financing can be evaluated by computing the ratio of the debt to the cash flow as an indicator of how long it takes to repay debt. Losses that are experienced after a default can be measured by the loan to value or the debt to equity ratio which evaluates how low the asset value can fall after a default arises. NINJA loans and sub-prime lending in general ignored the potential for repayment from cash flow or re-financing and concentrated on the source of repayment from selling assets.

In evaluating loans and using benchmarks, lenders can apply the historic track record of defaults as well as the amount of money that is recouped after the loan defaults (probability of default and loss given default) to assess the risk of the loan. The statistical analysis could consider the three repayment methods discussed above including some measure of debt service or interest coverage, ratios that gauge the size of the loan to the cash flow and the loan to value or debt to capital ratio. As the sub-prime lending was more aggressive than historic practices, the probability of default could be extrapolated even if specific data on the aggressive subprime loans was not available. For example, the probability of default on a conventional loan may be in the range of 3% and the probability of default on sub-prime loans could be extrapolated to something like 7%. The dramatic change in defaults on real estate loans during the housing crisis relative to historic levels is demonstrated on Figure 2.6. The graph shows that historic charge offs did not provide any indication of what was about to happen. Statistical extrapolation of historic data did not work.



Problems with this type of extrapolation when very different loans are made can be demonstrated using analysis of the ratio of loan to value. Consider an extreme case of a 100% loan to value ratio and assume an equal probability of housing prices increasing or decreasing. In this situation if there is a 50% chance that the value of the asset will fall and a 50% chance that the value will increase, meaning the probability of default is also 50%. If the loan to value ratio was 70% instead of 100%, then the house prices could fall by 30% before defaults would occur from the standpoint of repayment from asset sales. If fact, as demonstrated by the graphs of the value of homes shown in Figure 2.2, the there was a higher probability that the value of homes would decline than they would increase meaning that the probability of default was very high. The problem of declining values is compounded by a basic principle of lending which dictates that if you don't put your own money into an investment, you care a lot less about the investment.

Lessons learned from extrapolating historic default statistics to the very aggressive and fundamentally different forms of loans that were being made are documented by a comment that "[t]he 'class of 2005 and 2006' borrowers were defaulting much faster than households which had taken out mortgages before those dates." As further demonstration that extrapolation of history could not be used for the different loans, the value that was experienced after default, or the loss given default was also much worse than amounts that would be expected from historic experience: "A particularly pernicious aspect of the defaults was that when this new breed of subprime borrowers walked away from their homes, they often left them in such a bad state that it was hard for lenders to realize any value from the repossessed properties. Until the autumn of 2007, Moody's had assumed,

on the basis of past housing cycles, that lenders could recoup 70 per cent of their loans in case of default. By October 2007, it had slashed that projection to just 40 per cent." Cases in which mistakes in lending were made include Petrozuata (Chapter __), Kitty Hawk (Chapter __), AES Drax (Chapter ___) and, most of all Eurotunnel (Chapter __) and Iridium (Chapter ___).

Failure of Fully Thought-out Downside Scenario Analysis in Evaluating Risks Associated with Contracts

In evaluating all sorts of project financed investments, one of the fundamental tenets is that risks to an investor can be reduced through signing contracts and transferring risk to the contractor. Investors and lenders may think the risk analysis can stop as soon as the contracts are in place. However a potential problem with this type of analysis experienced in many of the subsequent case studies is that if contracts do not make economic sense, the chances of the contracts being not being honored can be high. If prices in the contracts are high relative to market benchmarks or other contracts (often because of perceived political risk), then the risk of the contract being broken increases. This is the primary subject of the Enron Dabhol Plant discussed in Chapter ___. Risk analysis of contracts should begin with whether the contracts are economic from the perspective of the person or institution making payments and the implicit trustworthiness of the party to make continued payments when the contract is not economic. Similarly, evaluation of subprime loan contracts that were made in the years leading up to the financial crisis should have considered both the economics from the perspective of the people paying mortgages and what actions would occur after contracts were not economic from their perspective. This kind of analysis should have included consideration of scenarios that go all the way from evaluating the economics of the subprime contracts to the affordability of the contracts for the ultimate person paying the bill. A downside scenario should have included the possibility of an economic recession. Similar issues occur in many of the other cases including Petrozuata (Chapter ___), Dahbol (Chapter ___), Quezon (Chapter ___), Eurotunnel (Chapter ___) and Iridium (Chapter ___).

Subprime contracts were famous for having relatively low interest rates at the beginning of the loan that increased by a large amount a year or a few years on. According to one source: "[m]ost investors built their pricing models around the sweet spot, the two-year adjustable mortgage with a three-year prepayment penalty, because it maximized revenue for everyone in the food chain." Loan contracts are different than long-term contracts with fixed prices because values in

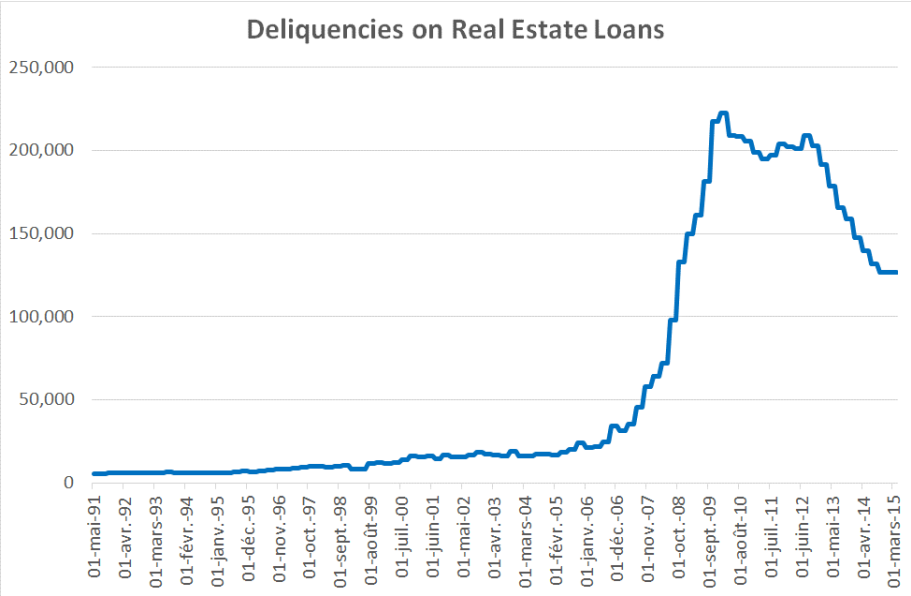
loans have to fall before the loans become uneconomic from the perspective of the person who makes payments on the contract. In long-term fixed price contracts like purchased power agreements for electricity generation, as soon as a reference price changes relative to the contract price, then the contract becomes uneconomic for one party or the other. Say a contract is signed for 10 years at a price of 100. If the price falls below 100, then the payer of the contract will be unhappy as he could buy whatever is in the contract for at a lower price. On the other hand, if the market price rises, then the supplier who receives contract payments rather than the buyer is upset because he could sell stuff to somebody else for a higher price. In the case of loans, there is generally a buffer before one or another party is disappointed. In the case of a real estate loan, if the loan is for 70 and the value of the house has a value of 100, the payer of the contract does not have a desire to get out of the contract until the price value of the house falls below 70. The lender is happy as long as payments for the contract is honored which should happen when the price is above 70.

The long-term fixed price contract could be termed a forward contract while the loan contract could be called an option contact. Evaluation of the contract with scenario analysis should first consider if the payer (the home buyer) will be unhappy; and, second, whether the buyer will continue to make contract payments when the contract is no longer economic from his perspective. Laying out the problem in this way practically provides the answer of what happened to subprime debt in the financial crisis. A scenario could easily be constructed where house prices fall, loan contracts become uneconomic and people are do not honor the contract after experiencing increased interest rates because, among other things like not understanding that the interest rate increases would occur, they simply cannot afford the debt service. With hindsight, this scenario that went all the way to the affordability of the contracts was not only possible, but should have been expected.

Scenario analysis of subprime loan contracts would probably have been a lot more helpful in evaluating the probability of default and the loss given default than statistical analysis discussed in the last section given the difference between these loans and more traditional loans. If the loan to value was close to 100%, then the contracts are really more like long-term fixed price contracts. Typical loan contracts have a buffer before the loan value exceeds the asset value. But if the loan value was close to the value of the home when the contract was signed, then as soon as the value would fall, the borrower would want to get out of the contract. Given the picture of housing prices in Figure 2.2, this was certainly not a crazy scenario. Once the contract is out of the money or the house is underwater, the next question in the scenario analysis is what happens in terms of whether the home buyer will continue to honor the contract. For subprime loans, after the interest rate increases, it became difficult for many people to afford the contract payments even if they wanted to make the debt service payments and honor the

contract. Thus, when the scenario is carried all the way to the ability to pay, the chances of default as well as the loss given default on the contract were in fact quite high. A scenario with 50% probability of default would not have been out of the question.

In making subprime loans with a high probability of default and loss given default, the interest rate that was required to account for the risk of the loans would have to be very high. Part 3 of the book discusses how the required credit spread or the cost of capital for debt can be approximated by the probability of default multiplied by the loss given default. If the probability of default is 20% and the loss given default is 60% then required credit spread would have to be at least 12% plus the base interest rate. This high interest rate may itself make the payments unaffordable. This high interest rate that is analogous to a country risk premium poses a dilemma that occurs in other case studies discussed later on as it did for subprime loans. When contracts are signed, you are supposed to pay off the contract even if it goes against you. But if somebody purchasing a home was very conscientious and tried to make debt service payments on a loan, it may be very difficult because of the required recovery from others who do not pay their loans. This can create a viscous circle. The interest rate must be high enough to recover losses after default, but the higher interest rate makes the loans unaffordable. The lack of affordability makes the default probability and the required spread higher. Continuing problems with people not paying their mortgages continued long after the initial housing shock. Figure 2.8 shows the rate of delinquency on all housing loans, of which subprime loans were a small fraction. The high rate of delinquency peaked in the middle of 2010 and continued long after the recession.



To demonstrate how scenarios actually played out in the financial crisis, the falling prices and loan defaults created a further viscous circle where housing values fell because of the loan defaults as illustrated by the following comment: "To add to the confusion, by the autumn of 2007 it seemed that events in some US neighborhoods were throwing the ratings agencies' models off even further. As house prices fell, defaults were rising to such a degree that they were blighting entire areas. That was pushing house prices lower still, sparking yet more defaults." This type of viscous circle where contract prices must cover inflated estimates of the country risk is present for Petrozuata (Chapter ___) and Enron Dahbol (Chapter ___).

Use of Simple Analytical Checks and Avoiding Unnecessary Financial Jargon

Discussion of blunders that were made in the lead up to the financial crisis has not yet mentioned those complex toxic securitized investments that many people claim were a big cause of the crisis because they are just too difficult to analyze. During the financial crisis, experts regularly appeared on television programs and used fancy financial language that and discussed credit default swaps, multiple debt tranches, structured investment vehicles, collateralization, systematic risk and many other sophisticated terms. Films and books on the financial crisis made it seem that all of this finance business was just too complicated for the average layperson to comprehend. Suggestions were made that the sophisticated securities should be outlawed or heavily regulated because they were too difficult to analyze. People who read a little about the crisis would proudly explained how mortgages were put together into a structured finance instrument and then cash flows of that thing would be distributed to different investors. The complexity of modeling is noted as follows: "The problem is that these instruments have become so incredibly complex that you need incredibly sophisticated computer models to work out their value."

The root of the financial crisis was the bubble in house valuation combined with bad lending practices at an individual loan level. The key to understanding what went wrong is understanding these fundamental economic issues and not going through a thirty page financial model. Sudden declines in the value of the complex CDO securities is not difficult to grasp once the economics of the underlying assets such as subprime loans measured. To demonstrate problems in valuation of loan packages, you did not need some highly elaborate financial model. Instead, a relatively simple structured finance model discussed in the next couple of paragraphs can demonstrate the problems with the so-called toxic investments and verify that the top-tier debt was not all that safe. This failure to

check seemingly complex analysis with basic cash flow models was a further analytical mistake made in the financial crisis. Similar failures to perform relatively simple analysis that demonstrated problems with business concepts are present in just about all of the case studies discussed in subsequent chapters.

One explanation of the collateralized securities that is enough to set up a financial model is the following: "Mortgages were transferred to a trust and then sliced or tranched horizontally into different segments, with different bonds for each segment. The trick was that the top-tier bonds, which represented say 70 percent of the value sold had first claim on all cash flows. Since it is inconceivable that 30 percent of a normal mortgage portfolio can default, top-tier bonds go triple-A, super safe ratings and paid commensurately low yields."[9] In terms of making a financial model, the bonds can be modeled as a cash flow sweep given that these bonds had the first claim on cash flows. Modeling this financial structure involves setting-up a debt schedule and connecting repayments to the assumed cash flows generated from mortgages.

After the financial crisis began, the effect of increasing defaults on the risk of a collateralized security was described in the context of defaults: "When the sub-prime CDO market first took off in 2005, sub-prime mortgage defaults were only 3%. A 20% cushion of equity and subordinated debt seemed like ample protection, so rating agencies generally assigned triple A to the top 80 percent of bonds in the CDO. Actual default rates were more than 10% and rising." [10] Default rates on individual loans that were much higher than 10% were very predictable, albeit with hindsight, from the combination of large decreases in housing prices, high loan to value ratios and the unlikeliness that people who have underwater mortgages will continue to honor loan contracts. Developing a financial model with different default rates, losses after default and interest income proceeds from the original loans can be structured as the source of cash flow, much like rental proceeds on a commercial building. With assumptions made for cash inflows from mortgages, the construction of a simple financial model that can evaluate what happens when the probability of default changes as suggested by the above quote along with rising loss given default rates.

One of the failings in many financial analyses and financial models these days is the problem of falling into a financial jargon trap without developing a simple way to verify the riskiness of an investment. To understand how CDO's worked and what happened to their value when defaults trended upwards, a relatively simple financial model with a cash flow waterfall can be built. You do not have to construct a whole lot of different sheets or to incorporate complex

[9] Jones, Sam, "The formula that felled Wall St", April 24 2009, The Financial Times Limited 2009, http://www.ft.com/cms/s/2/e3b972fc-3aa6-11de-8a2d-00144feabdc0.html

[10] Tett, Gillian, How panic gripped the world's biggest banks, May 8 2009 http://groups.google.com/group/misc.invest.stocks/browse_thread/thread/bc3ea42a6f0acd25

stochastic equations. You simply need to know how to use the minimum function in excel spreadsheet and, more importantly, organize your thinking and your model in a logical and structured manner that reflects how the loans will be repaid. The model organization should separately emulate how the sub-prime money inflows arise and where that money goes. You begin with a few assumptions about the interest rate received on the subprime debt and the interest rate paid for top-tier bonds. In modeling how much money is received, you also need inputs for the probability of default and the loss given default. Once you create a model and think about scenarios where housing prices fell below the value of loans and where people did not make contract payments, you can use the model to see that the top-tier bonds were not really that safe at all. You do not have to be an expert in systematic risk, collateralization or credit default swaps.

If you want to see the details of how the models are constructed, you can go to the associated website www.edbodmer.com and watch a YouTube video that works through the model on a line by line basis.[11] As the length of the video explaining how to build the model from scratch is less than half an hour, you will hopefully agree that the model is not some kind of highly complicated analysis that only a few highly paid financial experts could construct. Figures 2.9 through 2.12 demonstrate parts of the simple structured finance model. The model begins with laying out assumptions for timing inputs, cash flow sources from sub-prime loans and default statistics. Assumptions for financing the structured finance vehicle is included after the inputs for the cash inflows. After setting-up the assumptions, the financial structure is presented in terms of a sources and uses of funds analysis. A key part of the model is computing the revenues realized from subprime mortgages after accounting for defaults and recoveries of loans that are not paid. This is just like any other financial model where the most important element is modelling revenues, expenses and capital expenditures.

With cash inflows established, the financing structure can be developed. This involves first structuring the balance of the top-tier debt and then connecting the repayment of the debt to a cash flow waterfall. The cash flow waterfall puts various parts of the model together. Cash inflows from the subprime mortgages are put on top of the waterfall. Then the cash flow is used to the maximum extent possible to pay off the top-tier debt through displaying some cash flow sub-totals and using the minimum function in excel (paying the lesser of the available cash flow or the beginning debt balance). Once the top tier debt is paid, the remaining cash flow is paid to the equity investors. The final part of the model computes the cash flows to the debt and equity investors and computes the IRR on the cash flow. If the IRR on the top-tier debt is below the stated interest rate, then a loss on

[11] The modeling techniques are documented in book Corporate and Project Finance Modeling, Theory and Practice. Bodmer, Edward.

the top-tier debt has occurred. Multiple different tiers could easily be computed for different structures by using the minimum function for each tranche.

Figure 2.9 shows how the assumptions are laid out in the simple CDO model. Some of the assumptions for the financial structure of the investment are on-time inputs that are constant over time. Other assumptions that can vary over time are shown on a year-by-year basis. The only assumption that is difficult to get your hands around is probability of default. If a probability of default of 15% per year on subprime is assumed, more than 50% of the loans default on a cumulative basis by year 5. The scenario shown on Figure 2.9 assumes a default rate of 5% for 4 years followed by the assumed stable default rate of 2%. By year 30, this results in a cumulated default rate of 48%. When presenting the model, years 1 through 5 and years 25 through 30 are displayed in order so that the model can fit on a page. Statistical analysis on historic default rates can be interesting, but it did not provide any insight with respect to realistic default rates. Assumptions shown in Figure 2.9 are hidden for the middle periods of the model.

Financial Structure Assumptions												
Amount of Subprime Loans	1,000.00			Project IRR	4.56%							
Loans/Equity	5			Equity IRR	5.91%							
Equity to Assets	20%			Debt IRR	3.50%							
Fees	7.00%											
Subprime Repayment Years	30.00											
Years of High Default	4.00											
Stable PD	2.00%											
Annual Assumptions		1	2	3	4	5	25	26	27	28	29	30
Rate Charged on Sub-prime Loans		6.50%	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%
High Default Period		TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
PD		5.00%	5.00%	5.00%	5.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Cumulative Loans Current	1.00	95%	90%	86%	81%	80%	53%	52%	51%	50%	49%	48%
Cummulative Default Percent		5%	10%	14%	19%	20%	47%	48%	49%	50%	51%	52%
LGD		30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Delay in Recoveries		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Interest Rate on Top-tier Debt		3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%

Figure 2.9 – Set-up of Assumptions in Simple Structured Finance Model

After the assumptions are developed, the sources and uses can be reported as shown in Figure 2.10. The sources and uses analysis is like a mini balance sheet and for the simple model it shows how much money is spent to buy subprime mortgages and to pay all of the fees to various parties. After compiling the amount spent, the amount to money coming from various sources and invested in the venture is displayed. A sources and uses statement is presented for each of the project finance cases in subsequent chapters. If equity is input into the project and the top-tier debt is reduced, the investment can absorb defaults and losses on default while still being able to fully repay the debt. If less equity is in the sources of funds, there is less buffer before which losses on the top-tier debt is realized.

Figure 2.10 assumes 20% equity corresponding to the example cited above. A lot about the structured investment can be understood by looking at this simple little statement.

Part 1: Sources and Uses of Funds

Uses of Funds	Amount	Percent
Purchase of Subprime Debt	1,000.00	93.46%
Fees	70.00	6.54%
Total Uses	1,070.00	100.00%
Sources of Funds		
Top-tier Debt	856.00	80.00%
Equity	214.00	20.00%
Total Sources	1,070.00	100.00%

Figure 2.10 – Sources and Uses of Funds in Structured Finance Model

After the sources and uses, the next part of this, or any other, model derives the cash inflows that are earned by the investment and that will be used to pay off the debt and equity that pay for the assets. For the subprime debt, the cash flow depends on three items. First, the debt service paid by homeowners is computed from the sub-prime loan interest rate with the interest rate increases, the prepayment fees and so forth. Next, the debts are adjusted for the amount of interest that is not paid because of default. Finally, the amount of recoveries is incorporated using the loss given default assumption. The cash inflow table that depends on the non-defaulted debt is shown on Figure 2.12. The example in Figure 2.11 shows that by the end of the mortgage the total loan balance is repaid. Recoveries of loan defaults are assumed to occur three years after the default occurs.

Part 2: Cash Flow Inflows from Subprime Assets

Balance of Subprime Debt and Cash Inflw		1	2	3	4	5	25	26	27	28	29	30
Opening Balance		1,000.00	968.65	937.44	906.33	875.31	279.67	237.68	193.97	148.46	101.03	51.59
Less: New Defaults for Year		20.00	19.37	18.75	18.13	8.75	2.80	2.38	1.94	1.48	1.01	0.52
Less: Repayment of Loans		11.35	11.84	12.36	12.90	13.60	39.20	41.33	43.57	45.94	48.44	51.07
Closing Balance	1,000.00	968.65	937.44	906.33	875.31	852.95	237.68	193.97	148.46	101.03	51.59	0.00
Interest Income		65.00	62.96	60.93	58.91	56.89	18.18	15.45	12.61	9.65	6.57	3.35
Recoveries from Defaults												
New Defaults		20.00	19.37	18.75	18.13	8.75	2.80	2.38	1.94	1.48	1.01	0.52
Recovered		14.00	13.56	13.12	12.69	6.13	1.96	1.66	1.36	1.04	0.71	0.36
Delayed Recoveries		FALSE	FALSE	FALSE	14.00	13.56	2.77	2.51	2.24	1.96	1.66	1.36

Figure 2.11 – Cash Inflows from Sub-prime Loans in Structured Finance Model

After the cash inflows are established, a table of the debt repayments should be constructed. The debt schedule always lays out the opening balance,

how the debt is repaid and the interest expense. For this model, the repayment of debt comes directly from the available cash flow that is computed in the cash flow waterfall. A provision for non-payment of interest expense is also incorporated in case the cash flow is not even enough to pay the interest. The amount of interest that cannot be paid also comes from the case flow waterfall. Figure 2.12 displays the part of the model for both the debt schedule and the cash flow waterfall. The only formula that is in the least bit complex are the formulas for debt repayment and for the defaulted interest. These formulas must consider whether the cash flow is negative or positive as well as the maximum level of the default. In the example shown in Figure 2.12, the debt is fully repaid by year 25 meaning the dividends can then be paid to equity.

Part 3: Debt Repayment Schedule for Top-tier Bonds		1	2	3	4	5	25	26	27	28	29	30
Opening Debt		856.00	809.61	763.15	716.56	655.83	0.00	0.00	0.00	0.00	0.00	0.00
Less: Repayment from Cash flow Analysis		46.39	46.47	46.58	60.73	61.10	0.00	0.00	0.00	0.00	0.00	0.00
Add: Defaulted Interest not paid		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Closing Balance	856.00	809.61	763.15	716.56	655.83	594.73	0.00	0.00	0.00	0.00	0.00	0.00
Interest Expense		29.96	28.34	26.71	25.08	22.95	0.00	0.00	0.00	0.00	0.00	0.00
Part 4: Cash Flow Watefall												
Interest Income		65.00	62.96	60.93	58.91	56.89	18.18	15.45	12.61	9.65	6.57	3.35
Add: Repayment		11.35	11.84	12.36	12.90	13.60	39.20	41.33	43.57	45.94	48.44	51.07
Add: Recoveries		FALSE	FALSE	FALSE	14.00	13.56	2.77	2.51	2.24	1.96	1.66	1.36
Net Cash Flow		76.35	74.80	73.29	85.81	84.06	60.15	59.29	58.42	57.55	56.67	55.78
Less: Interest Expense		29.96	28.34	26.71	25.08	22.95	0.00	0.00	0.00	0.00	0.00	0.00
Cash Flow for Debt Repayment		46.39	46.47	46.58	60.73	61.10	60.15	59.29	58.42	57.55	56.67	55.78
Repayment of Debt		46.39	46.47	46.58	60.73	61.10	0.00	0.00	0.00	0.00	0.00	0.00
Equity Payment		0.00	0.00	0.00	0.00	0.00	60.15	59.29	58.42	57.55	56.67	55.78

Figure 2.12 – Cash Inflows from Sub-prime Loans in Structured Finance Model

Once you build the model with these few sections, you can see the difficulties in construction a packaged security from subprime loans. If the equity investors are to receive a good return, there must be a big spread between the interest rate earned on subprime loans and the interest rate paid on the top-tier debt. If the interest rates on the sub-prime debt and the top-tier debt were similar, then there would be nothing left for equity holders. This means the top-tier bonds had to get a good credit rating. If there was a lot of equity put into the structured investment, the IRR for equity investors also declines. Using the model the structuring challenges are demonstrated. The interest income must cover (1) defaults from the subprime mortgages; (2) payment of fees; (3) debt service on top-tier debt and (4) payments to equity investors. The trouble is that the cash flow earned from subprime debt was not enough to go around to all of these parties.

More important than illustrating structuring difficulties in setting-up collateralized debt instruments, the simple model shows that the top-tier debt could not be classified as very low risk with almost no chance of default. For a loan to be rated AAA there would have to be virtually no chance that the loans

could default. In terms of our model, this implies that no reasonable default probability and loss given default could result in the IRR on the top-tier debt being lower than the stated interest rate. Using a sensitivity tool in excel (the data table), defaults on the top-tier debt are illustrated in the Figure 2.13. The question raised by this table is whether the scenarios that are shaded in the table are conceivable. If the credit rating is AAA, they do not have to be likely. For the top-tier debt to have a very high rating, the scenarios that are shaded would have to be virtually impossible.

	Years of High Default	5.00			
		Loss Given Default			
		30.00%	40%	50%	60%
	3.00%	3.50%	3.50%	3.50%	3.50%
	6.00%	3.50%	3.50%	3.50%	3.50%
	9.00%	3.50%	3.50%	3.50%	3.50%
Prob	12.00%	3.50%	3.50%	3.50%	3.50%
Default	15.00%	3.50%	3.50%	3.38%	2.82%
	18.00%	3.50%	3.50%	2.75%	2.10%
	21.00%	3.50%	3.09%	2.11%	1.36%
	24.00%	3.50%	2.58%	1.47%	0.61%
	27.00%	3.48%	2.07%	0.82%	-0.16%
	30.00%	3.11%	1.56%	0.17%	-0.94%

Figure 2.13 – Sensitivity Analysis on Top-tier IRR from Alternative Probability of Default and Loss Given Default Assumptions

Using the scenario analysis described above, the possibility of defaults on top-tier debt was not surprising. Given high loan to value statistics and large declines in the value of homes, it would be surprising if loans did not default. Further, again because of the possibility of declines in housing prices, the loss given default could be 60%. While this scenarios that are shaded may not have seemed highly likely before the financial crisis, the idea of an AAA bond rating was that it was virtually impossible. Default rates could not be simulated from historic data and people could not afford interest rates on the subprime mortgages. One could argue that the shaded areas were not only possible but likely outcomes. The bonds should not have been rated AAA and you do not need a really fancy model to demonstrate this fact. A simple model explains what the collateralized debt was not a viable financial security and it was not responsible to assign a high credit rating to this debt.

Believing that New-Fangled Financial Products Can Change the Fundamental Relationship between Risk and Return

Finance attracts very creative and smart people who are sometimes paid a whole lot of money. One of the objectives of these intelligent people is to come up with innovative new products just like professionals at Google try to come up with new products like goggle glasses. When finance professionals create new ideas and new products they can sound convincing by using fancy terms and talking fast to make sure you will be thoroughly confused. As with other industries, people from the general public want to be part of a new idea that can make a lot of money such as getting in early on a company that produces a new kind of electric car. The new financial products seem to be no different than other innovative products that have the potential to take off. In the financial crisis, investments in structured investment seemed to have earn a better return for a given level of risk than other securities and create value for investors. Companies like Lehman Brothers would make presentations about just how wonderful the products were from an investment perspective. With hindsight we now know that the innovative financial products did not make risk somehow disappear. The implicit belief that financial investments could create value through reducing risk was yet another flaw that occurred in the financial crisis and in other valuation nightmares.

Packaged loans appeared to be able to take a lot of risky loans (you could call them crappy) and make them into safe AAA loans. Perhaps this was should have been called financial alchemy: "The first mortgage-backed bonds were created in the late 1980s… structured finance was a process of pure alchemy: a way of turning myriad messy mortgage loans into standardized, regimented and easy-to-assess bonds..." Innovative investment bankers had somehow seemed to be able to reduce risk and at the same time allowed a whole new class of buyers to own homes. In fact, as demonstrated in the last section, the securities had not reduced risk, but instead transferred risk to different parties in different ways. People could not really afford the mortgage on homes and there was not enough cash flow to create AAA on top-tier debt and provide adequate returns to junior investors. The only magic from the structured debt obligations was to convince rating agencies to assign less risk to the top-tier and other debt than they should have as explained in the previous section. The valuation lesson here is that when a new kind of financial instrument or financial theory appears in finance that seems to create value or reduce risk from nothing, it is probably rubbish. For just about any investment you can earn a lot of money if you understand how cash flow is generated and you are better than others at identifying cash flow trend. But

thinking that you can make a lot of money on the financing side of the equation is different. When moving between one source of funds and another, all that is happening is that risks are being transferred from one party to another.

The structured investment products came on the heels of the dot com bubble when analogous thinking about creating value from new concepts was even more common. At the turn of the century, a popular term was the new economy. For stocks in the new economy, thinking about value in terms of prospective cash flow and risk was considered old fashion. Stocks that did not earn any cash flow could obtain high valuation because they had things like a lot of hits on their website. As with investments that were supposed to somehow reduce risk, most of the companies that did not earn money and for whom it was relatively easy to copy and idea failed.

Using Mathematical Analysis to Simulate Risk when Variables do Not Follow Conventional Statistical Patterns

Rather than using financial models that were relatively simple as described in the section that describes making basic verification checks, in the lead-up to the financial crisis very elaborate mathematical models were applied. These models contained the implicit belief that the manner in which people pay mortgages could be translated into a mathematical equation with probability distributions. These equations could include complex mathematics using correlation factors and something called coplets. Once the equations were established, a Monte Carlo simulation could be made to measure the probability that the top-tier debt would default. As the statistical analysis required historic data and because the housing market had changed in such fundamental ways, the historic data was irrelevant and the mathematical analysis that seemed so sophisticated was worthless. There was no way that payments received from subprime mortgages with high loan to value ratios approximated a normal distribution where historic data on standard deviation could be used to predict future volatility. As in other valuation cases that went bad, presuming that businesses could be represented as mathematical equations ended up providing a very false comfort that the loans were much safer than they really were.

Before the financial crisis, people in banking had become somewhat attached to the idea of using statistical analysis since the Basel II banking accord that was established a few years earlier. Ironically this accord, which is named after a beautiful city in Switzerland, was supposed to assure that a banking crisis would not occur and create systematic risk. Banks were supposed to use

sophisticated mathematical analysis to predict the probability of loss and the loss given default for every loan. In some contexts, using mathematical analysis from an equation that measures potential dispersion can be reasonable. For oil investment, the notion of proven and probable reserves comes for geological analysis that uses geological data. This probability analysis does not depend on human actions and may be reasonable. In the case of wind and solar electricity projects, historic data may also provide a good basis for statistical analysis (even though famous mistakes have been made in estimating wind production). However when it comes to predicting whether a low income household will make payments on a loan that is underwater and gauging the potential dispersion in housing prices during the bubble, predicting dispersion is quite another matter.

The way in which statistical analysis was used rather than examining the scenarios of individuals who borrowed money is illustrated by a couple of comments from people who work for Moody's: "Moody's did not have access to the individual loan files, much less did it communicate with the borrowers or try to verify the information they provided in their loan applications." Instead, Claire Robinson, a 20-year veteran who is in charge of asset-backed finance for Moody's stated: "We aren't loan officers…Our expertise is as statisticians on an aggregate basis. We want to know, of 1,000 individuals, based on historical performance, what percent will pay their loans?"[12] Using statistical analysis, beautiful graphs can be created and sophisticated math can be used, but these

The manner in which mathematical analysis was used in investment analysis before the financial crisis is described as follows for determining the credit rating of a bond: "From an ordinary desktop computer, you start the Moody's rating software. A window opens in which you set the basic assumptions: duration of bond, payment, and collateral details ... and then – click – the simulation is set running. Not once, but a million times, each time with a different outcome. It's the average outcome from all those simulations that gives you a rating. Unfortunately for bondholders, there was a bug in the software. More importantly, the statistical models used to assess complex securities relied on historical patterns of default. This assumed that the past trends continue to be relevant even though sub-prime loans and other mortgages were nothing like loans made earlier."[13] The fundamental lesson is that all of the sophisticated financial models, elaborate mathematical representations of risk, application of intricate finance theory and other analytical tools are irrelevant without being supplemented by a healthy dose of wisdom and business sense. Many learned the hard way that risks associated with lending money to a waitress in who puts no money down on

[12] Tett, Gillian, How panic gripped the world's biggest banks, May 8 2009 http://groups.google.com/group/misc.invest.stocks/browse_thread/thread/bc3ea42a6f0acd25

[13] Jones, Sam, "When junk was gold", Financial Times, October 17 2008, http://www.ft.com/cms/s/0/65892340-9b1a-11dd-a653-000077b07658.html

a $500,000 house cannot be gauged by running thousands of simulations by a credit analyst at Standard and Poor's on the 50th floor of an office building in Manhattan.

And the correlation model was still mapping the housing market as it had been in 1990s, not the grossly inflated monster it had become. On August 10 2004, however, the rating agency Moody's incorporated Li's Gaussian copula default function formula into its rating methodology for collateralized debt obligations.

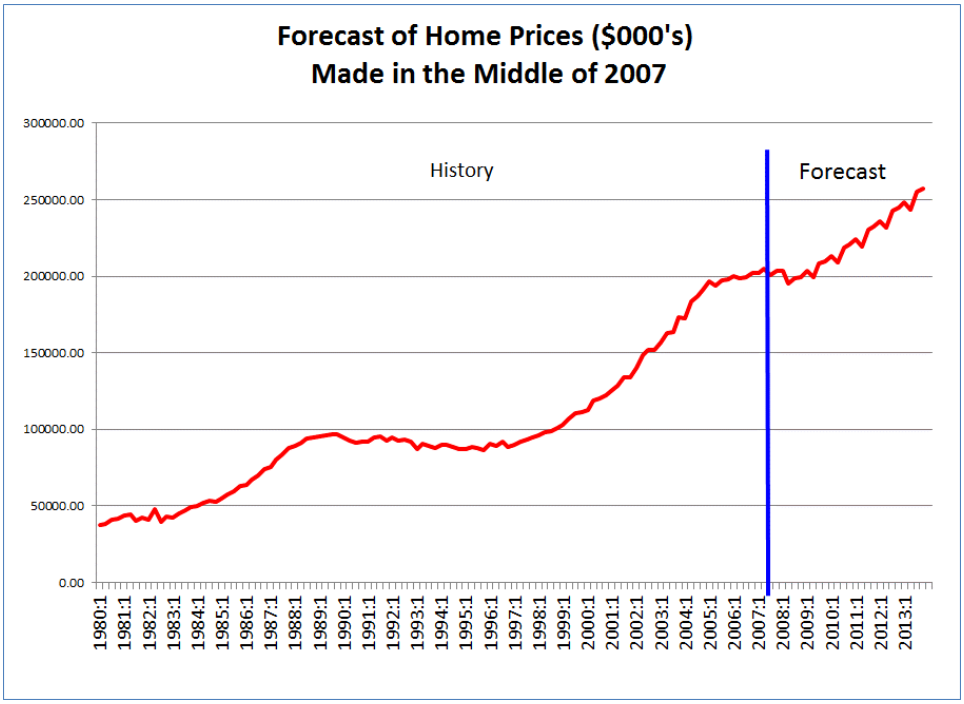
CDOs built solely out of subprime mortgage debt became the rage. And using the magic of the Gaussian copula correlation model, and some clever off-balance-sheet architecture, high-risk mortgages were re-packaged into triple-A-rated investor gold. The CDO market exploded. In 2000, the total number of CDOs issued were worth somewhere in the tens of billions of dollars. By 2007, two trillion dollars of CDO bonds had been issued.

Over-Reliance on Experts who have No Direct Economic Interest in the Investment

Forecasting the future and measuring risk – the foundation of value -- are both very difficult. Because of this it is natural to rely on people who have a good reputation, a fancy degree or who sound very sophisticated to help with the process. For many of the corporate and project finance failures discussed in subsequent chapters, experts gave very bad advice. In the subprime crisis a large reliance was placed on credit rating agencies to assess risk and negative perceptions of rating agency behavior in the financial crisis remains today. The process of making loans for housing investments involved many entities other than rating agencies who got paid but did not take risk by holding an investment. To construct a packaged mortgage investment, many entities that did not hold the loan package (CMO) earned fees. Mortgage brokers solicited and screened applicants. Mortgage banks bid for loans and held them until they had enough to make a CMO. Investment banks designed and sold CMO bonds. Ratings agencies and other entities made big mistakes when measuring the value of various debt instruments leading up to the financial crisis. While various experts ranging from company management to well paid consultants cannot be avoided in the valuation process, the lesson learned from many failed projects ranging from wind farms to toll roads to simple investments in stocks is that the advice should be fully understood and critically questioned.

In the case of projecting housing prices prior to the financial crisis, despite the clear oversupply of housing and the bubble in housing prices, prominent

economic forecasters projected continued increases in housing prices and housing starts. Figure ___ shows a forecast made by the well-known forecasting company Global Insight. The graph shows that despite the historic run-up in prices, future housing prices were projected to continue on their merry way upwards after a small downward blip in 2008. Comparison of the Global Insight forecast demonstrates how shown in Figure _____ with actual housing prices displayed in Figure ___ demonstrates that even highly educated forecasters using sophisticated financial models believed that a pending collapse due to over-supply was not imminent. The few people who got it right went to poor neighborhoods and saw first-hand that people could not afford their mortgage payments.



Problems with reliance on credit rating agencies was a more serious issue in the financial crisis. After Moody's Credit Agency became a publically listed company 2000, its managers adopted the philosophy that it was in the service business rather providing objective information. /one of its executives is quoted as asserting: "We're in the service business, I don't apologize for that."[14] The problem is that entities which receive a rating are the entities that generate revenue and cash flow for the rating agencies. There were stories of analysts from the credit agencies going skydiving with clients of structured finance as well as weekend getaways, golf outings and karaoke nights. As one former Moody's

[14] Financial Times.

staffer recalls: "The change was just precipitous. There was suddenly a concentration on profits. Management got stock options. It's true there was a big personality shift in the company – lots of cozying up to clients went on." The bias in incentives is clear. If the rating was too low, entities that wanted a credit rating could go elsewhere. Similar incentive problems exit for companies that prepare reserve reports, traffic studies and wind analyses and clear upward biases that lead to increased valuation can be found in all sorts of other cases. Before the crash in real estate, rating agencies could earn $200,000 from providing a rating that was acceptable to bond issuers. When the housing boom was at its height, the rating agencies attempted to process a very large volume of transactions. The Financial Times quoted an analyst who had to rate a $1 billion structured deal in 90 minutes.

Mistakes made by the credit rating agencies are well documented. In one case Moody's estimated that a package of loans could potentially incur losses of 2 percent from people not defaulting on mortgages. They were wrong. With the decline in the value of homes and lower incomes, the loan package was revised to have a loss estimate of 27 percent. The value of this package of loans plunged by half and a triple-A layer of bonds was been downgraded 16 notches, all the way to a rating of B.[15] Perhaps if Moody's made an investment in the bonds, they would have made the same assessment. On the other hand, they may have more fully researched the investment and discovered the potential for losses in a scenario where housing prices fell and mortgages where not paid.

[15] Financial Times, IBID.